

## Useful Tips for Actual Low Carbohydrate Diet (LCD) with Super-, Standard- and Petit-LCD Methods

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### Abstract

Among several kinds of nutritional therapy for diabetes, a low-carbohydrate diet (LCD) has been effective for weight reduction and improving glucose variability. Authors and colleagues have continued clinical practice, research and education for developing LCD through various activities of Japan LCD promotion association (JLCDPA). The diet protocol includes super-LCD, standard-LCD and petite-LCD, which has a carbohydrate ratio of 12%, 26% and 40%, respectively. Recommended food for LCD would be an egg, cheese, meat, tofu, beans and so on because of their less carbohydrate content. We hope further understanding and prevalence of LCD in health and medical care.

**Keywords:** Low-Carbohydrate Diet (LCD); Super-LCD; Japan LCD Promotion Association (JLCDPA); Prospective Urban Rural Epidemiology (PURE) Study; Ketone Bodies

### Abbreviations

LCD: Low-Carbohydrate Diet; JLCDPA: Japan LCD Promotion Association

### Introduction

Diabetes has been currently a major medical and social problem in developed and developing countries. According to the newest report, an estimated 4.2 million deaths for adults (20 - 79yo) are attributable to diabetes [1]. Approximately half deaths (46.2%) related to diabetes have found under the age of 60 years, in which the highest of 73.1% in Africa and lowest of 31.4% in Europe region [1].

For nutritional treatment for diabetes, several kinds of diet therapy have been introduced such as Mediterranean diet, low-fat (calorie restriction, CR), low-carbohydrate diet (LCD) and so on [2,3]. Among them, LCD was initiated by Atkins, Bernstein and others in Western countries, and has been spread in the health and medical region for years [4].

In contrast, authors and colleagues in Japan have begun and developed LCD by medical reports, books, workshops and other opportunities [5]. We continued diabetic clinical practice and research on CR, LCD, ketone bodies, meal tolerance test (MTT) and others [6,7]. There have been lots of comparative studies between CR and LCD [8]. We proposed many people how to continue LCD easily and practically through Japan LCD promotion association (JLCDPA). They are super-LCD, standard-LCD, petite-LCD with carbohydrate content in 12%, 26%, 40%, respectively [9]. We have applied LCD to more than 2700 patients with obesity, diabetes and metabolic syndrome. As a result, average weight reduction was 6.6% on average, and 2.6% - 9.8% in quartiles 25% - 75% with 4.3 kg reduction in average [10].

The lectures and workshops of LCD for patients and general people have been continued [11]. Among them, one of the pictures slides with an analysis of the carbohydrate amount is shown (Figure 1). It is a lunch of meat sauce spaghetti with salad and fruits, which has been

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a very popular cuisine in western countries. This includes a sum total of 130g of carbohydrate. It seems to be too much carbohydrate for the subjects who want to reduce weight or improve diabetic status [9]. Meat alone contains essentially no sugar, but cooking meat with various spices and others will result in high sugar content. Fruits originally have many carbohydrates included.

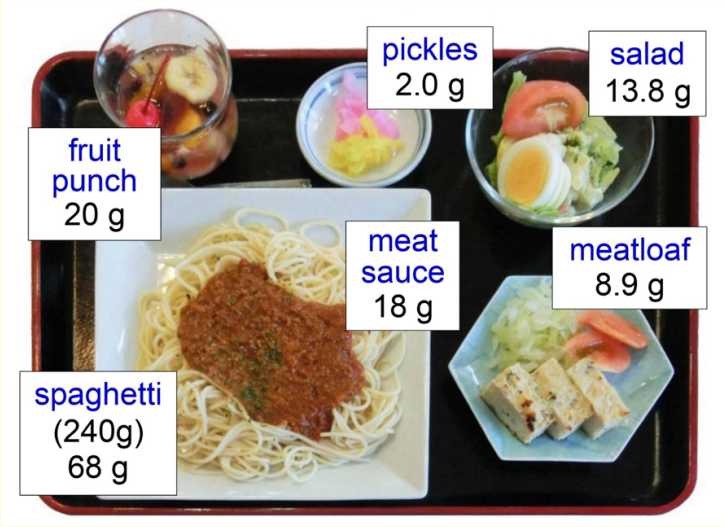


Figure 1: The sample of carbohydrate amount in a meal.

As to adequate advice to continue LCD successfully, there is a good idea to be understood easily. There is almost a limited carbohydrate amount per meal. The approximate permitted amount of carbohydrate in a meal would be less than 40g in petite-LCD, 30g in standard-LCD and 20g in super-LCD [9]. According to the situation of lifestyle and diseased state, everyone can select either of LCD. The most simple way of petite-LCD is to have no carbohydrate in the supper, while free eating in breakfast and lunch [11].

There are some recommended methods for continuing LCD. Some foods have fewer carbohydrate and certain protein from a nutritional point of view. Figure 2 shows the typical 5 kinds of food with fewer carbohydrates, such as egg (50g) 0.1g, cheese (20g) 0.2g, chicken meat (180g) 0.4g, tofu (300g) 4g and beans (100g) 8g [9]. When a person tries to LCD, the fundamental dishes include i) salad at first, ii) meat, eggs or fish (protein), iii) encourage liquids without sugar, iv) refrain from carbohydrate foods such as rice, bread, pasta, etc [11].

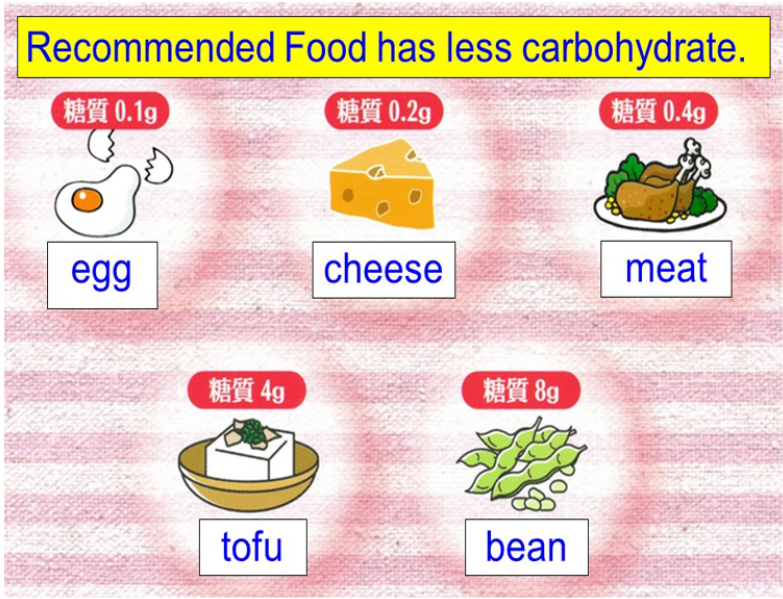


Figure 2: Recommended foods adequate for continuing LCD.

Historically speaking, LCD was formerly started for a strategy of reducing weight. After that, it had been developed in a various manner including the activities of Atkins and Bernstein [12]. Today, the definition of LCD has not been apparently decided yet. However, Bernstein and Feinman, *et al.* proposed a standard guideline for the definition of LCD related to the carbohydrate percentage content in the daily meal.

It shows 4 categories as follows [13]: i) Very low-carbohydrate (< 10% carbohydrates) or 20 - 50 gm/day, ii) Low-carbohydrate (< 26% carbohydrates) or less than < 130 gm/day, iii) Moderate-carbohydrate (26% - 44%) and iv) High-carbohydrate (45% or greater).

There is a hypothesis for the beneficial mechanism of LCD [14]. Insulin has been a critical hormone that produces an anabolic and fat-storing condition. LCD can reduce the secretion of insulin, then can reduce weight and improve cardiometabolic functions. Recently, it has been called the carbohydrate-insulin model [15].

When a person continues a strong restriction of LCD, it would become the ketogenic diet, which is a special version of LCD. Usually limitation of carbohydrate to 20 - 50 grams a day would bring ketogenic diet with the elevation of blood ketone bodies, including acetoacetate (AcAc), beta-hydroxybutyrate ( $\beta$ -HB) and acetone [7]. This is nutritional ketosis, and it shows serum ketones to 1 - 7 mmol/L without metabolic acidosis. On the other hand, diabetic ketoacidosis reveals metabolic acidosis, hyperglycemia and elevated ketones (more than 20 mmol/L) [16].

From various reports of comparison between CR and LCD, LCD has been evaluated to be effective for weight reduction, improving glucose variability and many beneficial effects due to hyperketonemia [17]. Ketone bodies may have specific anti-oxidative, anti-inflammatory effects and increasing mitochondrial substrate oxidation [17].

Several studies were found about LCD and cardiovascular relationship. There was an increased risk for mortality with carbohydrate intake < 40%, which report was rather rare [18]. However, Prospective Urban Rural Epidemiology (PURE) study with over 135,000 subjects across the world, showed a significant relationship of higher carbohydrate intake and increased mortality, as well as higher fat intake and lower mortality [19]. Thus, the efficacy of LCD on cardiovascular axis would be controversial [20]. As to the relationship between lipids and LCD, some recent systematic reviews are found [21,22]. In response to LCD, there is a favorable reduction of triglycerides, increase of HDL-C and probable small decrease or an increase in LDL-C [21,22].

### Conclusion

In summary, the authors have conducted clinical research on LCDs and spread the methods of super-, standard and petite-LCDs for years. We showed some educational slides with actual sugar content and introduced recent topics in this article. I hope it will contribute to the development of LCD in the future.

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